PHYTOTOXICOLOGY SURVEY REPORT:

NARCO CANADA LIMITED

CALEDONIA (1992)

JUNE 1994

Ontario

Ministry of
Environment
and Energy

ISBN 0-7778-2728-X

PHYTOTOXICOLOGY SURVEY REPORT:

NARCO CANADA LIMITED - CALEDONIA

REPORT FOR 1992

JUNE 1994

Cette publication technique
n'est disponible qu'en anglais.

PIBS 3102

PHYTOTOXICOLOGY SURVEY REPORT:

NARCO CANADA LIMITED

CALEDONIA (1992)

Report prepared by:

J. Craig Kinch
Phytotoxicology Section
Standards Development Branch
Ministry of Environment and Energy

ABSTRACT

A soil survey was conducted in the vicinity of Narco Canada Inc., Caledonia on June 3, 1992. Although particulate emissions have been associated with the plant, visual surveys of vegetation off the property did not suggest that the facility was a current source of phytotoxic air pollution. Soil chemical data indicated that the facility did not have a measurable impact on off-site surface soil quality. However, bulk concentrations of some elements (boron and to a lesser extent sodium) in soil and non-soil solids in the vicinity of an on-site by-product disposal area were elevated. These compounds, in combination with other physical factors (flooding and root suffocation) may have contributed to on-site tree damage and mortality at the base of the disposal area. Although the material in the disposal area was found to be elevated in some inorganic elements, leachate analyses did not result in any of the samples being characterized as subject or hazardous waste.

BACKGROUND and INTRODUCTION

Narco Canada was a small, high-temperature brick manufacturing company located in a mixed industrial/residential area on Stirling Street in Caledonia, Ontario. The facility was operated for more than a decade until operations were recently relocated to the U.S.. The raw products known to be used in the manufacturing process included; fire clays, calcine clays, calcium aluminate cement, aluminum oxide, silicon carbide, chromium (3) oxide, boron carbide, phosphoric acid, boric acid, citric acid, phenolic resin and formaldehyde resin. The most probable sources of contamination from the facility were 1) vented dusts from the mixing area (currently trapped in an air filtering system that was installed approximately 10 years ago) and 2) leachate and fugitive dust from a disposal area at the back of the property that has received spilled process materials, dust from the collection system, and sludge from the sump area over the years of operation of the plant.

During the plants operation, the Hamilton District Office of the Ministry of the Environment and Energy (MOEE) received complaints from neighbouring residential properties alleging excessive particulate emissions from the plant and vegetation damage associated with these emissions. Residents were also concerned that tree damage and mortality on the Narco property were associated with leachate from the disposal area at the back of the property. The Hamilton MOEE Office responded to these complaints by initiating an investigation that consisted of a number of field visits. On one of those visits, samples of grey granular material from the disposal area were sampled. Leachate analyses of the samples indicated that while aluminum concentrations were elevated in the material, it would be considered non-hazardous.

The District Office requested the assistance of the Phytotoxicology Section in the investigation because of continued vegetation and soil related complaints associated with the facility and because of the pending re-location of the company. This report summarizes the results of sampling conducted on June 3, 1992 by Craig Kinch and Dave McLaughlin, Phytotoxicology Scientists, Phytotoxicology Section, Standards Development Branch.

METHODOLOGY

Vegetation assessments and soil collections in the vicinity of Narco were conducted by J. Craig Kinch and D. McLaughlin, on June 3, 1992. Eight sampling locations were selected around Narco to include; two residential properties bordering the plant (Locations 1 and 2), an agricultural field just to the east (Location 3), a location at the toe of the disposal area and in the area of tree damage (Location 4), three locations in the disposal area (Locations 5, 7 and 8) and a control site located in a park 10 km from Narco (Location 6). The following table provides a brief description of the sampling locations and the samples collected;

Location Number	Location Description	Samples Collected
1	198 MacCrae (bordering SW corner of property)	Turf Soil (0-5 cm) (backyard)
2	168 MacCrae (bordering property and inline with drainage from disposal area)	Turf Soil (0-5 cm) (backyard)
3	Agricultural Field (bordering property to the east)	Cultivated Soil (0-15 cm)
4	Toe of Disposal Area (20 m from base in area of tree damage)	Scrub Forest Soil (0-5 cm)
5	Disposal Area	Non-Soil Solids - Composites (0-25 cm)
6	Control Area (park 10 km from Narco)	Turf Soil (0-5 cm)
7	Green Granular Waste (from disposal area)	Non-Soil Solid (grab sample)
8	Dust Collector Sample (from disposal area)	Non-Soil Solid (grab sample)

Soil (and non-soil solid) samples were all collected in triplicate. Each soil sample consisted of a minimum of 50 individual cores collected from random locations within the sample area using a stainless steel corer. Because of the homogenous nature of the material at Locations 7 and 8, single composite samples of the non-soil solids were collected as grab samples. Samples were stored in plastic bags during transport to the Phytotoxicology processing lab. Samples were oven-dried, ground in a Wiley-mill and stored in glass bottles. Processed samples were submitted to the MOEE laboratory in Etobicoke for hot acid extractions (bulk/total analysis). The elements tested were copper [Cu], nickel [Ni], lead [Pb], zinc [Zn], iron [Fe], manganese [Mn], aluminum [Al], boron [Bo], cadmium [Cd], cobalt [Co], fluorine [F], molybdenum [Mo], sodium [Na], strontium [Sr] and vanadium [V]. Five of the eight sampling locations were selected for dilute

acetic acid leachate analysis (required under Regulation 309 of the EPA for determination of waste status). Triplicate samples from these sites were submitted for leachate concentrations of the above elements with some minor differences (leachate samples also analyzed for barium [Ba], berillium [Be] and titanium [Ti] but not for fluorine [F]).

RESULTS and DISCUSSION

At the time of the investigation, there were no signs of fluoride or any other air pollution-type injury on any of the plant species examined. The survey included examination of a number of sensitive species in close proximity to the facility and in residential areas that have experienced excessive dust. There was, however, substantial tree damage and mortality in a small scrub woodland at the toe of the disposal area (Site 4), with approximately 10-12 dead aspen and hickory trees. The accumulation of material in the disposal area (Site5) and at the toe of the area (Site 4) had resulted in flooding and root suffocation. Regardless of the contamination status of the soil, the mechanical damage caused by this material being piled around the trees would have been sufficient to cause tree mortality.

The analytical results for bulk (total acid-extractable) concentrations of elements in soils are presented in Table 1. Where available, the Phytotoxicology ULN guidelines (see appendix) are also listed in these tables. The ULN is the arithmetic mean of the element in urban surface (0-5 cm) soils collected away from point sources of pollution, plus three standard deviations of the mean. There is a high probability that concentrations in soils exceeding the ULN are above background and the result of contamination from a pollution source. Concentrations exceeding the ULN are, however, are not necessarily toxic to plants, animals or people. The ULN should only be used for comparisons to other surface soils and should not be used to guide abatement activities involving soils collected below 5cm or non-soil soilds (eg. industrial by-products).

The urban ULN guidelines were exceeded at one or more locations for B and Mn in soils (Table 1). Boron concentrations in soils were consistent with the disposal area and waste by-products on the site being a source of boron to soils at the toe of the disposal area adjacent to the dead trees. Concentrations of B in soils at the toe of the dump (Site 4, 130 ug/g) were approximately 9 times higher than the ULN for urban soil (15 ug/g). The total B concentration in material collected from the disposal area was elevated (Site 5, 230 ug/g), as was the concentration in the dust collector composite sample (Site 8, 73 ug/g). Notably elevated was the concentration of B in the green granular sample collected near the top of the disposal area (Site 7, 750 u/g). This material was also noted by the investigators to be interspersed in the material making up the disposal dump. Chromium was also elevated in the green waste (220 u/g).

In the case of Mn, the exceedences of the urban ULN occurred in locations that did not implicate Narco as a source (Table 1). Manganese is known to be quite variable in soils and in all probability, the observed concentrations were within normal background variation.

Although no ULN guideline is currently available for Na, concentrations of Na at the toe of the disposal area (Site 4) and samples collected from the disposal area itself (Site 5) were substantially higher than in soils collected from adjacent residential and agricultural properties and

from the control site. The highest Na concentration was in the dust collector sample, confirming the Narco operation as a Na source.

Therefore, the results of bulk inorganic analysis of soils would suggest that the disposal area is a source of B and Na to the wooded area at the base of the dump (Site 4). Both B and Na are known to be phytotoxic and are potentially injurious at the concentrations detected at Site 4 where the tree mortality occured. However, the mechanical injury to the trees caused by the pile of material (flooding and root suffocation) would have been at least if not more significant than that cuased by the B and Na soil contamination. It should be emphasized that both vegetation damage and soil contamination were confined to the Narco property and that no evidence was found to suggest that neighbouring residential properties were being affected.

The results of dilute acetic acid leachate analyses are summarized in Table 2. These leachate analyses provide the basis for waste characterization required under Regulation 309 of the EPA. In general, samples that do not exceed 10 times the Leachate Quality Criteria (LQC), outlined in Schedule 4 of Reg. 309, are not considered waste. Samples with leachate chemistry that exceed the LQC by 10 to 100 times are considered Subject Waste and require special consideration under the EPA for transportation and disposal. Samples that exceed the LQC by more than 100 times are considered Hazardous Waste and are more strictly regulated under Reg. 309.

The leachate results indicated that all samples collected had concentrations of inorganic elements that were well below those that would result in the material being considered a subject or hazardous waste. However, as with the bulk analysis, leachate concentrations of material in the disposal area (Site 5) is implicated as a source of boron. Soils at the toe of the disposal area (Site 4) were also elevated in B relative to the control. Aluminum concentrations were also notably elevated in the dust collector sample, which was consistent with observations made earlier by the local Environmental Officer.

4.0 SUMMARY

Although particulate emissions have been associated with the plant, visual surveys of vegetation off the property did not suggest that the facility is a current source of phytotoxic air pollution. Similarly, the soils data indicated that the facility did not have a measurable impact on off-site surface soil quality. However, bulk concentrations of some elements (boron and to a lesser extent sodium) in soil and non-soil solids in the vicinity of an on-site by-product disposal area (Site 5) were elevated. These compounds, in combination with other physical factors (flooding and root suffocation) may have contributed to on-site tree mortality at the base of the disposal area (Site 4). Although the material in the disposal area (Site5) was found to be elevated in some inorganic elements, leachate analyses did not result in any of the samples being characterized as subject or hazardous waste.

Table 1: Mean* Concentrations of Inorganic Elements in Total Extractions of Soils Collected from Narco Canada Incorporated, Caledonia - July 3, 1992.

Location	Concentrations of Inorganic Elements in Soils (u/g)															
	Cu	Ni	Pb	Zn	Fe	Mn	Al	B	Cd	Co	Cr	F	Mo	Na	Sr	V
1 (198 Maccrae)	24	24	19	71	24000	730	21000	12.5	0.38 T	12	27	73	DL	120	86	38
2 (168 Maccrae)	25	22	25	78	23000	590	19000	11.6	0.36 T	10	24	74	DL	120	64	36
3 (Field east of property)	20	29	24	76	31000	1060	26000	7.7	0.35 T	16	32	42	DL	78	30	47
4 (Toe of Disposal Area)	25	26	34	110	23000	1400	25000	130	0.41 T	11	32	47	DL	680	112	38
5 (Disposal Area)	12	18	20	34	4700	100	17000	230	0.30 T	2.4	37	35	0.75 T	390	95	37
6 (Control)	23	21	28	80	23000	600	19000	8.8	0.32 T	9.6	23	49	DL	94	58	34
7 (Green Granular Material from Disposal Area)	4 T	3.6	15	10 T	2200	45	11000	750	0.23 T	3.1	220	29	1.6 T	550	34	30
8 (Dust collector sample)	13	27	20	69	4600	87	12000	73	0.32 T	1.6 T	14	31	1.2 T	940	65	64
ULN Guidelines	100	60	500	500	35000	700	NG	15	4	25	50	NG	3	NG	NG	70
Clean-up Guideline**	300	200	1000	800	NG	NG	NG	NG	8	100	1000	NG	40	NG	NG	200

ULN Phytotoxicology Upper Limit of Normal (ULN) guideline for urban soils, see attached appendix. All units in u/g.
* Mean of triplicate samples
** MOE Clean-up Guidelines for Soils-Guidelines for the Decommissioning and clean-up of soils in Ontario. All units in u/g.
T A measurable trace amount. Interpret with caution.
DL Below analytical detection limit, no measurable response (zero).
NG Guideline not established.
NC Not calculated.
Note: Shaded data exceed ULN and/or Clean-up Guidelines. B and Cr at Site 7 and B at Site 8 also exceed the ULNs, but these data are not shaded because they were not "soil" samples.

Table 2: Mean Concentrations of Inorganic Elements in Leachates of Soils Collected from Narco Canada Incorporated, Caledonia - July 3, 1992.

Location		Concentrations of Inorganic Elements in Soil Leachate (u/g)																
		Cu	Ni	Pb	Zn	Fe	Mn	Al	Ba	B	Be	Cd	Co	Cr	Mo	Sr	Ti	V
4 (Toe of Disposal Area - Soil)		0.007	0.03	0.07	DL	0.19	9.9	0.3	0.18	7.5	DL	DL	DL	DL	0.02	2.4	DL	DL
5 (Disposal Area - Fill)		DL	0.03	0.04	DL	0.24	0.6	DL	0.04	6.0	DL	0.0006 T	DL	DL	0.01	0.8	DL	0.0012 T
6 (Control - Soil)		0.003	0.01	0.02	DL	0.03	0.17	DL	0.11	0.2	DL	DL	DL	DL	0.005	1.1	DL	DL
7 (Green Granular Material from Disposal Area)		DL	0.01	0.04	DL	0.02	0.29	0.03	0.009	19	DL	DL	0.02	DL	0.014	0.1	DL	0.0091
8 (Dust collector sample)		DL	DL	0.05	DL	0.02 T	0.25	1.7	0.27	3.7	DL	DL	DL	0.001 T	0.027	1.1	DL	0.12
Reg. 309	Subject Waste	NC	NC	0.5	NC	NC	NC	NC	10	50	NC	0.05	NC	0.5	NC	NC	NC	NC
	Hazardous Waste	NC	NC	5	NC	NC	NC	NC	100	500	NC	0.5	NC	5	NC	NC	NC	NC

T A measurable trace amount. Interpret with caution.
DL Below analytical detection limit, no measurable response (zero).
NC No Leachate Quality Criteria (EPA, Regulation 309, Schedule 4) available.

APPENDIX I

Derivation and Significance of the MOEE Phytotoxicology "Upper Limits of Normal" Contaminant Guidelines

The MOEE Upper Limits of Normal (ULN) contaminant guidelines represent the expected maximum concentration in surface soil, foliage (trees and shrubs), grass, moss bags, and snow from areas in Ontario not exposed to the influence of a point source of pollution. Urban ULN guidelines are based on samples collected from developed urban centres, whereas rural ULN guidelines were developed from non-urbanized areas. Samples were collected by Phytotoxicology staff using standard sampling procedures (ref: Ontario Ministry of the Environment 1983, *Phytotoxicology Field Investigation Manual*). Chemical analyses were conducted by the MOEE Laboratory Services Branch.

The ULN is the arithmetic mean, plus three standard deviations of the mean, of the suitable background data. This represents 99% of the sample population. This means that for every 100 samples which have not been exposed to a point source of pollution, 99 will fall within the ULN.

The ULN do not represent maximum desirable or allowable limits. Rather, they are an indication that concentrations that exceed the ULN may be the result of contamination from a pollution source. Concentrations that exceed the ULN are not necessarily toxic to plants, animals, or people. Concentrations that are below the ULN are not known to be toxic.

ULN are not available for all elements. This is because some elements have a very large range in the natural environment and the ULN, calculated as the mean plus three standard deviations, would be unrealistically high. Also, for some elements, insufficient background data is available to confidently calculate ULN. The MOEE Phytotoxicology ULN are constantly being reviewed as the background environmental data base is expanded. This will result in more ULN being established and may amend existing ULN.